Noesis

The Journal of the Hoeflin Research Group

(Issue 29, August 1988)

Editorial

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The July meeting: Chris Cole, Dean Inada, James Hajicek, Keith Raniere, Ray Wise, and the Editor met on July 2, 3, and 4 for 8 hours per day. (Ray could attend only on Sunday morning.) Topics discussed included (1) Keith's method of norming the Mega Test, (2) cellular automata and artificial intelligence—Chris Cole's one-page summary is included in this issue, (3) Newcomb's paradox—a two-page summary will appear in next month's issue, (4) how to calculate the volumes of hyperspheres of n dimensions—James Hajicek sent me his equations but I will not include them in this journal since I would like to use this problem in my new Titan Test for the 4-dimensional case, (5) a summary of my Ph.D. dissertation, including an extension of my theory to Zeno's paradoxes of motion, (6) an interpretation of a computer programming method called, I believe, "Prologu," that James Hajicek proposes, and (7) a few minor topics such as the employment prospects for chiropractors on Long Island vs. Connecticut.

Membership: Fifteen out of seventeen members have remained with us for Issues 25 through 27. They are

1. Geraldine Brady of Chicago, Illinois
2. Anthony J. Bruni of Plano, Texas
3. Chris Cole of Newport Beach, California
4. H. W. Corley of Arlington, Texas
5. James Hajicek of Burlington, Wisconsin
6. Eric Hart of Miller Place, New York
7. Dean Inada of El Toro, California
8. C. M. Langan of Speonk, New York
9. Richard May of Boston, Massachusetts
10. Johann Oldhoff of Solna, Sweden
11. Keith Raniere of Clifton Park, New York
12. Marilyn vos Savant of New York, New York
13. Cedric Stratton of Savannah, Georgia
14. Jeff Ward of San Diego, California
15. Ray Wise of Huntington, New York

Thus two-thirds of our members live in just three states: New York (5 members), California (3 members), and Texas (2 members).

Status of the Titan Test: No date has been set for publication in Omni yet, but I did receive a phone call from Scot Morris, the puzzle editor, on July 25 and he went over a few details with me such as the scoring fee and the person to whom checks should be made out. I had already reduced the length of the test on Scot's recommendation —from 8 pages to just 4—without reducing the number of problems, and some people at Omni thought I should accordingly reduce the scoring fee. I sent Scot some counterarguments by letter. More recently I also suggested that Omni might want to consider my doing an annual test of 25 or 30 problems in which the top 25 scorers would b listed in Omni. For the Titan Test I had already suggested listing the top 100 scorers as an incentive for people to try the test.

After the Four Color Problem

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A recent issue of Noesis includes a letter from one David Geiger, who asks whether there will ever be "another problem like the four-color problem" of combinatorial topology. Because this question touches on one or two of my past contributions to the journal, I'll take the baton this time around the track.

First, I'll clarify the question: given the structure and history of the four-color problem, does it have a logical successor of similar allure and importance? We will address this question alone, if even at the expense of airtime for other famous but still unproven conjectures (e.g., Riemann's hypothesis, Poincaré's conjecture, and Fermat's last theorem, a supposed proof of which was recently discredited after a promising introduction).

The four-color problem - how to concisely prove or disprove the conjecture that any map drawn on the surface of a sheet or sphere can be colored with at most four colors such that no two countries sharing a linear boundary are colored alike - is undeniably one of the deepest and most notorious mathematical mysteries of all time. Many tried and failed to solve it, or to convert the "conjecture" into a "theorem". The simple way in which the problem can be stated served as an irresistable lure to amateur and professional mathematicians, who saw in this the promise of a similarly compact solution...as well as instant acclaim. The desired proof became a "holy grail" of sorts, and myriad thinkers squandered much time in pursuit of it. But as more and more of them made the attempt, they acquired the expertise to discredit the attempts of others, and it came to seem that no short, valid proof could ever be found.

This eventually prompted a pair of University of Illinois mathematicians, Kenneth Appel and Wolfgang Haken, to de-emphasize concision and attempt to "automate", or computerize, the search for a counterexample to the conjecture. The speed of automation, they perceived, would allow them to forego a theoretic, pencil-and-paper treatment in favor of a direct, exhaustive empirical examination of all planar maps, where the terms "direct" and "empirical" are defined to allow for mechanical implementation. Though their technique had a limited theoretic component (i.e., a "discharging algorithm" executed over a complete classification of planar maps), this component was relatively weak: the number of equivalence-classes of planar maps relative to available theorems was too large, and too many possibilities had to be sequentially examined. Thus, after around twelve hundred hours of mainframe computation, they had generated a "proof" of such prodigious length that no single human mathematician could ever hope to follow and retain the entirety of it.

Nevertheless, the mathematical community was generous with its applause, hailing the effort as the dawn of a new age in mathematics: the Age of Automated Proof. Henceforth, human mathematicians perplexed by difficult conjectures could forget about proving them directly, instead concentrating on exhaustion algorithms for execution by machine. Verification of such "proofs" could now be limited to the validation of algorithms and empirical repetition of their mechanical determinations. Computers could now be entrusted with some of our thinking at even the deepest, most fundamental levels.

Of course, a considerable number of mathematicians held back.

For them, the concept of "proof" meant something very different: a proof was supposed to be something they could read and study in its entirety to enhance their understanding of a conjecture and its context. Since a protracted "yes" or "no" decision by a machine is merely a phenomenal result of the mentative process by which comprehension might be attained, they felt subtly cheated by the prospect that this process might sometimes be too complex to live outside the digital womb. They had, after all, been taught by the likes of Gödel to regard truth and proof as distinct concepts. Anyone, human or mechanical, can state the truth of a conjecture; but until its proof is directly validated, nothing of common intellectual value has openly transpired.

From these rather soggy ashes there arose anew a problem of even greater generality and profundity: what are the limits of mathematics, and how much can we hope to know at first hand within a reasonable amount of time? This problem corresponds in large measure to another famous problem of tremendous scope, symbolised by the notation P =? NP. Translation: if a problem can be quickly solved by guessing and verification, is there always a recursive procedure by which the solution can instead be quickly calculated?

Certain problems are more difficult than others. Problems are ranked in terms of the minimum amount of time required to solve any of their instances. The easiest problems belong to the class P (for "Polynomial-time"), which means that each of their instances can be solved in a number of steps expressible as a polynomial function of the number of variables it contains. All class-P problems ("2 + 2 = ?", for example) are "tractable" to a DTM (for Deterministic Turing Machine), the abstract formulation of a device which executes a determinate sequence of definite steps to reach its "halting state" with a final determination on its input.

However, there is a more powerful machine model, the NDTM (for "NonDeterministic Turing Machine"), which "guesses" towards its halting state. The problems tractable to it are those of the class NP (for "Nondeterministic Polynomial-time"), which are often easy to state and have easily-stated solutions (if the solutions were not easy to state, the NDTM could take too long stating them to halt in polynomial time). The subclass (NP - P), if nonempty, contains problems whose solutions may be tractably expressed, but for which no deterministic polynomial-time algorithms can ever exist. The numbers of steps required to solve them by the fastest possible algorithms are thus exponential functions of the numbers of variables they contain. There are also classes of verifiably difficult and insoluble problems intractable to DTM's, NDTM's, and even prescient OTM's (Oracular Turing Machines) that always guess correctly. Since the human accessibility of a proof depends on its length and the time needed to compute it, the issue of computative tractability bears heavily on the understandability of proofs.

Thus, the four-color problem has an even greater successor, P =? NP... which is especially suitable in that its theory incorporates the problem of determining the chromatic numbers of maps of arbitrary dimension. It thus "embeds" the four-color problem and may be considered a logical extension of it. Those who know the most about this problem and its ramifications - it is in a sense the ultimate problem in deductive logic and therefore in any chiefly-deductive science - are not necessarily those with the highest profiles as researchers.

In fact, neither problem is generally well-understood, even by the professional logicians and mathematicians who have worked on it. But collective limitations sometimes have isolated exceptions. There is a great deal of competition for insight concerning such problems, much of it among large commercial enterprises to which time, and the understanding that leads to fast algorithms, equals money. This has created an atmosphere of secrecy around some lines of research, in part because American proprietary law gives little protection or incentive to mathematicians not working under some corporate or institutional aegis. Truth, so the argument goes, is the birthright of all mankind, and pure mathematics is truth.

But even so, unaffiliated and uncredentialed researchers may have difficulty believing that such a rationale is anything but hypocritical in today's information-intensive economic and political climate... particularly when noncorporate funding for pure mathematics has all but dried up. Were it true that all of the brightest minds had been found and recruited by companies and institutions through the good offices of universities and academic guilds, this kind of competition might best promote the growth of new ideas despite its disadvantages. But there is ultimately no good reason to believe this. Because the study of computation is critical to so many of the complex problems facing global society, the resulting situation offers little to laugh about.

On the other hand, if the solutions to such problems do already exist, then the ramifications are in all likelihood being investigated to the best ability of those responsible, even given the possible necessity that they go it alone. For the few and dedicated, truth itself is the supreme motivator.

As a footnote, let's modify Mr. Geiger's question by defining problemic similarity in terms of common variables and contextual restrictions. Then the most obvious nontrivial unsolved analogue of the four-color problem is a parallel formulation of the "m-pire problem" (apparently so-named by Herbert Taylor in a letter to Martin Gardner), which departs from the latter chiefly in its admission of an additional degree of freedom in how planar regions may be defined. While it lacks some of the glamor of its cousin, it is easily as important... though one must know more about it to see why. In addition, the problems are of comparable antiquity and were pondered by some of the same mathematicians.

The m-pire problem is constructed from the planar map-coloring problem by associating with each simply-connected country $(m - 1)$ other countries on the same map. Each "empire" thus consists of m simply-connected regions, all of which must be colored alike. Now we merely formulate an analogue of the four-color conjecture with respect to our redefinition of "countries" as (m-part) "empires". This was done in 1890 by the Englishman P. J. Heawood, who set an upper bound of $6m$ on the number of colors required for any such map. Thus, we may define a "$6m$-color conjecture" for planar m-part empire maps: "For each integer $m \geq 2$, there exists a planar m-pire map which can be colored with no <u>fewer</u> than $6m$ colors such that no two empires anywhere sharing a linear boundary are colored alike." To prove or disprove this statement is to solve the problem.

Cellular Automata and Artificial Intelligence

Chris Cole

During the July 4 meeting of the Hoeflin Research Group, we discussed the application of cellular automata to the problem of artificial intelligence. Cellular automata are machines composed of many interconnected cells or processors. One example of a cellular automata is (may be) the human brain. In the brain, the cells are the neurons and the interconnections are the axons and dendrites. Clearly, the brain is a quite complex cellular automaton since it contains about 10^12 neurons and 10^15 interconnections. If the brain is indeed a cellular automaton, then it may be possible to achieve artificial intelligence by building a sufficiently complex cellular automaton.

The problem is: how complex is sufficient? If the interconnections of the cellular automaton must be completely specified, the complexity of the human brain is daunting. However, if the interconnections are random, then it may be possible to build a very complex cellular automaton with very little requirement for detailed design information. What design information there is can (it seems) be specified with three parameters:

1) The program executed by each (type of) cell
2) The statistical distribution of the interconnections
3) The number of cells

Randomly interconnected cellular automata have been systematically studied by many researchers. The results, although empirical, are intriguing. The automata seem to fall into three classes:

1) Constant or repeating patterns of behavior
2) Random behavior
3) Self-organizing behavior

Could it be that intelligence is a form of self-organizing behavior that spontaneously occurs (during a phase transition) in a sufficiently complex cellular automaton? Could the three parameters listed above describe a phase space of behavior, much like pressure, temperature and volume do for gases? Can we formulate a statistical mechanics of intelligence? If so, can we create artificial intelligence in a cellular automaton simpler than the brain?

One major question that has been begged is: are the neurons in the brain randomly interconnected? It is well known that there are many specialized structures in the brain: along the optical pathway, for instance. Although the neurons in the cortex appear to be randomly interconnected, perhaps they exhibit structure on a larger scale, much like a hologram. Perhaps this explains instincts, behavior patterns, collective unconscious, etc.

Two objections to the idea of large scale structure to the cortex:

1) There is not enough information in DNA to code for it
2) Simpler random cellular automata exhibit self-organizing behavior

At any rate, much interesting work remains to be done in this area.

Answers to "Word Quiz One"

yes = is in the dictionary   no = not in the dictionary

1.	yes	26.	yes
2.	yes	27.	yes
3.	yes	28.	no
4.	no	29.	yes
5.	yes	30.	no
6.	no	31.	yes
7.	yes	32.	no
8.	no	33.	no
9.	yes	34.	no
10.	yes	35.	no
11.	yes	36.	yes
12.	no	37.	no
13.	yes	38.	no
14.	no	39.	no
15.	yes	40.	yes
16.	yes	41.	yes
17.	no	42.	no
18.	yes	43.	no
19.	no	44.	yes
20.	yes	45.	yes
21.	yes	46.	no
22.	no	47.	no
23.	yes.	48.	yes
24.	no	49.	yes
25.	yes	50.	no

Answers to "Word Quiz Two"

1. 1907
2. 1947
3. 1727
4. 1923
5. 1962
6. 1949
7. 1927
8. 1939
9. 1942
10. 1938
11. 1851
12. 1955
13. 1670
14. 1883
15. 1925
16. 1946
17. 1863
18. 1915
19. 1880
20. 1860
21. 1969
22. 1891
23. 1974
24. 1966
25. 1897
26. 1902
27. 1931
28. 1780
29. 1884
30. 1884
31. 1955
32. 1967
33. 1688
34. 1920
35. 1849
36. 1903
37. 1907
38. 1887
39. 1909
40. 1939
41. 1815
42. 1892
43. 1977
44. 1884
45. 1957
46. 1783
47. 1969
48. 1868
49. 1868
50. 1932

Mathematicians Turn to Prose in an Effort to Remember Pi

By MALCOLM W. BROWNE

"HOW I want a drink, alcoholic of course, after the heavy lectures involving quantum mechanics!"

No, the foregoing plaint is not the latest evidence that faltering American physics students are succumbing to the lure of demon rum. It merely exemplifies a growing body of mnemonic phrases that are supposed to help people remember the value of pi — the ratio between the circumference and diameter of a circle. If the number of letters in each word is counted as a single digit, then the sentence reads: "3.14159265358979," the approximate value of pi.

Mathematicians and scientists readily acknowledge that such putative memory joggers are generally harder to remember than the numbers for which they stand. Moreover, in the case of pi, there is scarcely ever any need to know more than the first half dozen digits after the decimal point.

Nevertheless, the writing of phrases, poems and even songs embodying the numerical value of pi has become a kind of sport for pi enthusiasts. In the current issue of Mathematics Magazine a Venezuelan mathematician has issued an appeal for new pi mnemonics in languages other than English, French, German, Spanish and Greek. He has already collected examples in those tongues.

In his article, Dr. Dario Castellanos of the University of Carabobo in Valencia, Venezuela, discusses the peculiar fascination pi has exerted on professional and amateur mathematicians over the centuries. Part of the number's appeal is that it is transcendental: the virtually random sequence of numbers following the decimal point is believed to be infinite.

Nevertheless, improved mathematical techniques have enabled researchers to calculate the value of pi to an immense degree of accuracy. With the help of a supercomputer and a mathematical tool called a quadratically converging algorithm, Dr. Yasumasa Kanada of the University of Tokyo last year established a record for pi. He calculated its value to 134,217,728 decimal places.

Memory prodigies around the world seek to outdo each other in digesting ever larger servings of pi. According to the Guinness Book of World Records, the current pi champion is Hideaki Tamoyori of Japan, who last year proved that he could remember 40,000 digits of pi.

Mnemonics have yet to be devised that could stand for really long approximations of pi, but for reasons best known to themselves, people continue to compose pi prose. Dr. Castellanos noted that in 1985, A. K. Dewdney, author of the computer column in Scientific American, invited pi mnemonics from readers, and received the following 20-decimal place example from Peter M. Brigham of Brighton, Mass.: "How I wish I could enumerate pi easily, since all these (censored) mnemonics prevent recalling any of pi's sequence more simply."

Pi mnemonics from Europe often honor the ancient Greek scientist Archimedes, who calculated pi to four decimal places before deciding that he had had enough. For example, Dr. Castellanos quotes a mnemonic poem in French encoding 30 decimal places of pi, which appeared in 1879 in a Belgian mathematical journal:

Que j'aime à faire apprendre un nombre utile aux sages!
Immortel Archimède, artiste ingénieur
Qui de ton jugement peut priser la valeur?
Pour moi ton problème eut de pareils avantages.
(How I love to learn a number useful to the sages!
(Immortal Archimedes, artist engineer
(Who can put a value on thy judgment?
(For me thy problem would have such advantages.)

According to Dr. Philip J. Davis, an applied mathematician at Brown University, some of the current interest in calculating and memorizing long sequences of pi is a consequence of "the Mt. Everest phenomenon, the urge to break records."

But more is involved than mere mention in the records books, Dr. Davis believes. "These computations of pi are not easy or automatic, you know," he said. "They give rise to computational complexity that forces investigators to devise new strategies for multiplying very large numbers. This kind of calculation is a stunt, I suppose, but it has to be staged properly, and it reveals useful mathematical applications.

"Every generation has found its own interest in pi and for ours, the interest is in computational technique rather than the mystery of the number."

NEWSDAY, SUNDAY, JULY 31, 1988

SHELBY LYMAN ON CHESS

Last July, a notable event occurred in the history of computer chess, when Hitech — designed by Hans Berliner of Carnegie-Mellon University — tied for first in the Pennsylvania State Championship. Indeed, after the application of a mathematical tie-breaking procedure, the machine was declared winner of the tournament. Trophy, cash prize and title of state champion, however, went to the runner-up, a human.

Recently, Hitech competed in the same event. The outcome? An undisputed first-place finish for the computer! And again the spoils went not to the victor but to the human runner-up, in this instance, Edward Formanek, a professor of mathematics at the University of Pennsylvania.

But Formanek, who was masterfully defeated by Hitech in the final round, paid tribute to Berliner and the computer by presenting them with the trophy. "I don't understand the rules they play by here," he explained. "This trophy doesn't belong to me. Hitech won the tournament. Here it is."

The final-round victory over Formanek, ranked 64th in the United States, gained Hitech a Senior Master's Rating (2405) — about 150th in the country. But in 48 games played since last August, it has had a performance rating of 2440, indicative of a playing strength that places the machine among the top 100 American players.

Hitech astounded spectators and players alike with its accomplished endgame play during its win over Formanek. with the tournament hanging in the balance, the computer aveaged only 30 seconds per move during its last 37 moves.

The endgame moves are given below. Play starts with the position given in the diagram labeled "Endgame."

In the starting position, White has the following pieces: king at KB2; pawns at K3, KN2, KR3; and knight at Q4. Black's pieces are: king at K4; pawns at KR2, KN2, KB3 and Q4; and bishop at QN2.

	Formanek	Hitech		Formanek	Hitech
41.	K-B3	P-R4	59.	PxQP	K-K5
42.	P-R4	P-N4	60.	N-K5	KxP
43.	P-N3	B-B1	61.	N-B7	B-K3
44.	NB6ch	K-Q3	62.	N-N5	B-Q4
45.	N-Q4	B-KN5ch	63.	N-R3	K-K5
46.	K-B2	K-K4	64.	N-N1	K-B4
47.	N-N5	B-Q2	65.	N-K2	K-N5
48.	N-Q4	K-K5	66.	K-N1	P-B6
49.	N-B2	B-QN4	67.	N-B3	B-B3
50.	N-Q4	B-R3	68.	K-B2	KxP
51.	N-K6	B-B1	69.	N-Q1	K-N5
52.	N-Q4	B-Q2	70.	N-K3ch	K-B5
53.	N-B2	PxP	71.	N-B1	P-R5
54.	PxP	B-KN5	72.	N-R2	P-R6
55.	N-Q4	P-B4	73.	N-B1	B-N4
56.	N-K6	P-B5!	74.	N-N3	P-R7
57.	N-QB5ch	K-B4	75.	N-R5ch	K-N5
58.	N-Q3	P-Q5!	76.	N-N3	B-B8! White resigns

'World's Smartest Couple' doesn't fit nerd mold

By MICHAEL VITEZ
Knight-Ridder Newspapers

NEW YORK — Science-fiction writer Isaac Asimov gave the bride away, declaring the marriage "a true meeting of the minds." The groom, ever the romantic, made the rings himself out of gold and pyrolytic carbon, the same material he used in inventing the world's most successful artificial heart.

The newlyweds spent six weeks in Paris on their honeymoon, but the bride — the world's smartest woman, with an IQ of "228.333 repeating" — described it as a busman's holiday. She took her portable computer, and he took his physics books.

"Most people don't consider physics a vacation," she says.

Robert K. Jarvik and Marilyn vos Savant, unofficially the World's Smartest Couple, have been married 10 months now. They live happily on the 39th floor of a high-rise on New York's West Side, their joint office across the hall.

They are the new Clark Kent and Lois Lane of Metropolis, he the superman scientist and she the writer.

He invented the artificial heart that bears his name, the Jarvik-7, and she — according to her résumé — is the only person in the world belonging to seven societies for the superintelligent, from Mega to Mensa to the International Society for Philosophical Enquiry.

Each is doing his own bit now to save or enlighten mankind — he is trying to develop a new heart that will save 50,000 lives a year, and she is trying to write great works on "politics and other social systems," although she rarely reads newspapers and never votes. Her principal contribution these days is an advice column called "Ask Marilyn" for Parade magazine, the Sunday supplement which appears in The Houston Chronicle and other newspapers.

With all this brainpower you might think these two race through New York Times crossword puzzles or play Scrabble for blood, or maybe converse in Latin. You might think he wears baggy black pants with chalk smudges. You might think she wears thick glasses and reads constantly. Wrong. Wrong. Wrong. His portrait has been splashed on the cover of Italian Vogue, and she won't pose for pictures on her balcony because the wind will muss her hair.

These people are not nerds. They are celebrities, "beautiful people." And they hate the nerd image.

"It doesn't correlate with reality," she says of the stereotype that smart people are supposed to "look bad, wear silly-looking socks, wear funny glasses and be small."

"What's true," she adds, "is that people who are brighter than average tend to be taller (she is 5 feet 8 inches), they tend to have better vision (hers is 20-15), they tend to have better hearing."

And clearly, the world's smartest couple is also a handsome one.

He is boyish, wiry and fit, although, at 42, having relocated from Utah, he's finding it harder to bike and hike in Manhattan. His hair is brown, curling up in the back. His pink-

Dr. Robert Jarvik invented the Jarvik-7 artificial heart and is now working on an "implantable permanent electrical" version. His wife, Marilyn vos Savant, who boasts the highest IQ on record, keeps busy by writing a syndicated column and writing books.

striped tie looks trendy, his black shoes look expensive.

And, at 41, with milky white skin, a cascading black mane of hair and her trim figure, it is no surprise that she was photographed for Vanity Fair a few years ago. Nor should it come as a surprise that he was profiled in Playboy, since one of the devices he reportedly invented can't be described in polite company.

Theirs is a media marriage. One born of fame and magazine pictures. Jarvik made the first romantic move two years ago, calling vos Savant for a date after reading a magazine article about her. She demurred at first, fearing he'd be the "obscure mathematician type."

Ever logical, she went to the library to check him out before calling back. "I wanted to make sure he didn't look like Dr. DeBakey," she says, referring to Michael DeBakey, the 79-year-old heart pioneer. She came across a picture of Jarvik in Vanity Fair, posing bare-chested. The rest is history.

They talked for several hours a day on the telephone for a month before their first date. Five days later he proposed.

Vos Savant was married twice before, and Jarvik once. Each has two children from previous marriages — hers are college-age, his are school-age — although the children have little part in their lives together.

"I don't consider either one of us to have children," she said. "In a biological sense, sure, but I'm not very sure if that's a very good way to define it. If you look at men who've donated to sperm banks, you know there are biological children running around out there, but I'm not sure if they believe that they have children. I think if we had children here, in an ongoing relationship, we would say yes."

Vos Savant, who hails from St. Louis, recorded her astounding IQ score at age 10. She lived for years in obscurity until a fellow member of the Mega Society wrote the Guinness Book of World Records of her high score.

Besides writing her column for Parade, she also is busy now writing books, although she would rather not talk about some of them. The world simply isn't ready yet for her deepest political or social insights.

"I think probably the best books in me are probably not to be published until after I'm dead, and then I won't have to listen to all of what people have to say about them," she said. "I wouldn't quite have the courage to live through the reaction."

Jarvik is all too happy to talk about his latest efforts, which essentially include starting up a new company, Jarvik Research (he is president, vos Savant is vice president), raising $25 million in seed money, and working away on what he calls "an implantable permanent electrical heart."

Jarvik wants to invent a new heart, one with no valves and just one moving part, a rotary blood pump. It would sit inside the diseased heart and operate on batteries carried in a vest and changed daily. He believes this invention could save 500,000 lives over 10 years.

July 1988

It says that the world is not yet ready for Marilyn's deepest political or social insights.

But perhaps there are readers of "Noesis" who would not be altogether unprepared for them. Could she perhaps print something in "Noesis" or at least give a brief indication of her insights?

S. Woolsey